

THE PHILIPPINE AGRICULTURIST

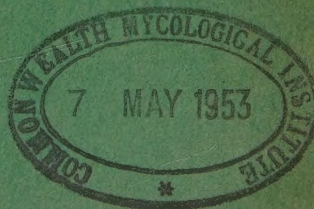
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TESTS OF FIVE INSECTICIDAL DUSTS IN THE CONTROL OF INSECTS AFFECTING TOMATOES AND EGGPLANTS¹

GETULIO B. VIADO AND ROMAN R. ESTIOKO, JR.

Tomatoes and eggplants, two important crops in the Philippines, are favorite hosts of some insect pests. When seriously affected, they often die or give poor yield. In spite of insect depredations, no control measure is ordinarily practiced by farmers because of lack of technical information.

The effectiveness of insecticides against some of the insect pests of tomatoes and eggplants has been reported by various workers. Michelbacher, Macleod, and Hoskins (1940), in their study of caterpillars that attacked tomatoes in northern California in 1939, found that of all the insecticides tested, which included 80 per cent cryolite, calcium arsenate minimized most the damage caused by *Heliothis armigera* (Hübner). Prescott (1940) studied control measures of insect pests of tomatoes in Victoria, Australia, and reported that a dust containing 50 per cent lead arsenate and one ounce calcium caseinate spreader in four gallons of water at intervals of from seven to ten days was effective against the tomato fruitworm. Watts (1941) conducted field experiments on the control of *Heliothis armigera* on tomatoes in South Carolina and found that of the insecticidal dusts he tested, 90 per cent of synthetic or natural cryolite and undiluted calcium arsenate were among the most efficient. He also found that 50 per cent calcium arsenate appeared to work slightly better than 50 or 30 per cent cryolite. Wilcox (1943) studied the rate of application and strength of cryolite dust mixtures for the control of the tomato fruitworm and found that undiluted cryolite containing 90 per cent sodium fluoaluminat was more potent than 70 per cent cryolite. Annand, *et al.* (1944) stated that 3 per cent DDT in pyrophyllite dust was more effective than undiluted calcium arsenate against the fruitworm on tomatoes. Friend and Pasfield (1945) reported that in preliminary trials conducted in New South Wales, Australia, 1 or 2 per cent DDT dusts and a 0.2 per cent DDT spray applied ten times at weekly intervals completely controlled *Empoasca* sp. on tomatoes. The treatments left satisfactory residual toxicity. In Louisiana, Floyd (1947) noted that 3 per cent DDT in Attaclay, 95 per cent synthetic cryolite in Attaclay, and calcium arsenate, applied five times at approximately weekly intervals, controlled the tomato fruitworm. He also found that DDT and cryolite worked better than calcium arsenate. White (1947)

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studied insecticides for vegetables and concluded that on tomatoes, DDT was more effective than either cryolite or calcium arsenate against the fruitworm. Common (1948), in his studies on the control of corn earworm on tomatoes in Queensland, Australia, reported that 2 per cent DDT dust with or without sulfur, applied every 15 days, gave results comparable with those of a dust consisting of lead arsenate, sulfur, and copper carbonate, in the proportion of 5:3:2. He found in subsequent experiments that DDT sprays were consistently more efficient than DDT or lead arsenate dusts. Hely (1949), studying the value of DDT in tomato pest control in New South Wales, Australia, noted that 1 to 2 per cent DDT dusts were slightly more effective against *Heliothis armigera* than the sprays. Wilcox and Howland (1950), working on some new insecticides against tomato insects in southern California from 1945 to 1949, found 5 to 10 per cent DDT dusts an excellent control for the tomato fruitworm. These investigators further concluded that benzene hexachloride dusts containing 2, 2.5, and 5 per cent gamma isomer, and dusts containing 5 and 10 per cent methoxychlor, 70 per cent cryolite, and 75 per cent undiluted calcium arsenate were less effective against this insect.

The control of *Heliothis armigera* on cotton has also been the subject of investigations, among which were those of Ewing and Parencia (1943), Ivy, Parencia, Moreland, and Ewing (1945), Ivy and Ewing (1946), Parencia, Ivy, and Ewing (1946), Ewing, Parencia, and Ivy (1947), Gaines and Dean (1947), Harned (1947), and Moreno (1949). On corn, which is also a favorite host of this insect, its control has been studied by such workers as Ditman (1943), Tate (1946), Butler and Carruth (1949), and Bacon (1950).

The present study was conducted on a piece of land loaned by the Department of Agronomy and in the laboratory of the Department of Entomology, College of Agriculture, to determine (a) the efficacy of five insecticidal dusts against some of the known insect pests of eggplants and tomatoes and (b) the effect of the dusts on the crops.

MATERIALS AND METHODS

A piece of land which had not been planted to any crop for three years was prepared for planting with a tractor.

Five Du Pont² insecticidal dusts were tested, namely: (1) Du Pont Deenate 10-X—a dusting powder containing 10 per cent DDT; (2) Du Pont Alorco cryolite—a fluorine insecticide containing 90 per cent sodium fluoaluminate; (3) Du Pont Marlate 50—an insecticidal dust containing 50 per cent methoxychlor; (4) Du Pont Lexone 50—a 50 per cent benzene hexachloride formulation containing 10 per

² Du Pont insecticides are manufactured by E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Delaware, U. S. A., and distributed in the Philippines by Macondray & Co., Inc., Manila.

cent gamma isomer; and (5) Du Pont calcium arsenate—containing not less than 40 per cent arsenic oxide and not more than 0.45 per cent water-soluble arsenic.

Fine "white earth,"³ which was ground and then passed through a 100-mesh sieve, was used to dilute Marlath 50, Lexone 50, calcium arsenate, and Alorco cryolite to the desired concentration of 10 per cent. Deenath 10-X was not diluted because it was already in the desired concentration. A plunger type of hand duster with a capacity of one-half pound was used for dusting.

In the laboratory tests, the test cages were empty one-quart Mason jars and cylindrical wire-screen cages fitted at each end with a tin can. As receptacles for the feed, small glass bottles filled with water were used. The holes on the cage covers were plugged with cotton.

Seeds of the native variety of tomatoes and of the Long Purple variety of eggplants, both obtained from the Philippine Bureau of Plant Industry, were used in this study.

Field tests. In the prepared field 50 furrows were laid 90 centimeters apart. Four-week-old seedlings of eggplants and tomatoes, about 15 centimeters high, were planted alternately in the furrows at a distance of 80 centimeters between hills. The plants were given the necessary care until the close of the tests. Dead plants were replaced immediately to insure uniform growth in the field. When the plants were two weeks old, ammonium sulfate fertilizer was applied at the rate of approximately 10 grams to a plant.

The plants were dusted three times during the experiment at two-week intervals between six and nine o'clock in the morning when the wind was calm. The first dusting was done soon after a considerable number of fruits had appeared. Care was taken to avoid, as much as possible, heavy depositions of dust on the plants.

Before dusting, each row was labeled with the treatment it was to receive. After dusting, observations were made on the effects of the different insecticides on the leaves, stems, flowers, and fruits of both crops and on the insect and red spider populations affecting them. The relative abundance of the pests before and during each treatment was observed.

The tomato fruits were harvested once a week. The following data were noted: (1) the total number of harvested fruits, sound fruits, and those damaged by fruitworms; (2) the number and weight of the fruits from each treatment; (3) the average number and weight of the fruits of each plant in each treatment; and (4) the number of plants in each treatment. On the eggplants, the fol-

³ Kaolin, which is largely aluminum silicate. It occurs in large deposits in Mt. Maquiling, Laguna.

lowing data were taken: (1) the total number and weight of fruits harvested; (2) the average number and weight of fruits to a plant; and (3) the number of plants in each treatment.

Laboratory tests. In one of the laboratory tests, two young tomato fruits were dusted with one insecticide and then placed in a test cage. One larva of the fruitworm, *Heliothis armigera*, was placed on top of each dusted fruit. The number of fruitworms that died and the extent of feeding were observed every 24 hours until all the fruitworms in the treated cages were dead.

In another test, second-, third-, and fourth-instar larvae of *Epilachna philippinensis* Dieke were used. In each test cage, each treated leaf was placed upright, side by side with an undusted leaf, in a small glass receptacle containing water and covered with a two-holed lid. The larvae were placed directly on the dusted leaves. One cage with two undusted leaves served as the control in each treatment. Observations on the repellent action of the insecticides, whether the insects fed on the treated leaf or not, the extent of feeding, and the number of dead larvae were noted every 24 hours until all the larvae in the treated cages were dead.

A similar procedure was followed in the preparation of tomato leaves for the tests with the adults of *Epilachna philippinensis* and of eggplant leaves for the adults of *Psylliodes balyi* Jacoby, *Psylliodes splendida* Harold, and the leafhopper, *Empoasca flavescens* Fabricius. The nature and extent of feeding and the number of dead beetles were observed every 24 hours until all the beetles in the treated cages were dead. The extent of feeding and the number of dead hoppers were noted after 3, 6, 8, 10, 24, and 36 hours. The test cages of the beetles were screened cages, and those of the leafhoppers, empty Mason jars.

DISCUSSION OF RESULTS

Insects that affected the plants

During the experiment, the pests that attacked the tomato plants in the field were (1) *Heliothis armigera*, (2) *Epilachna philippinensis*, and (3) red spiders. Those that attacked the eggplant were (1) *Empoasca flavescens*, (2) *Aphis gossypii* Glover,⁴ (3) *Epilachna philippinensis*, (4) *Psylliodes balyi*, and (5) *Psylliodes splendida*.

Woodworth (1921), Metcalf and Flint (1939), and Uichanco and Sacay (1949) stated that *Heliothis armigera* [*Chloridea obsoleta* Fabricius, *Heliothis obsoleta* (Fabricius), *Heliothis assulta* Guenée] attacks corn, cotton, tobacco, and tomato. This insect is known as corn earworm in regions where it injures the ears of corn, as cotton bollworm where it bores into young cotton fruits, and as tobacco budworm where it bores into the buds and seedpods of tobacco. Uichanco reported in 1915 that the larvae of this insect destroyed

⁴ Identified by Dean L. B. Uichanco, Department of Entomology.

about 50 per cent of the season's tomato crop. The caterpillar bores a hole in the fruit and eats a portion of the flesh. It stays inside until the fruit ripens, when it sometimes comes out to bore into another fruit. A single caterpillar is thus able to injure a number of fruits before it pupates. According to the same author, the wound on the fruit sometimes heals, but more often, infection sets in, resulting in total damage to the fruit.

Prescott reported in 1940 that in Victoria, Australia, *Heliothis armigera* was the most serious pest of tomato fruits, causing as high as 50 per cent damage to the crop. The larva, according to this investigator, enters the stem end of the fruit so that the damage very often is overlooked. A larva may travel from one fruit to another. In the absence of fruits, it attacks the buds, flowers, and even the leaves. Metcalf and Flint (1939) stated that in the United States, this insect is considered the worst pest of corn and one of the most serious on tomato. From 50 to 80 per cent of the tomato fruits are sometimes destroyed.

Epilachna philippinensis is an important insect pest of both the tomato and the eggplant. The larva and the adult eat the succulent portions of the leaves, scraping away the tissues and leaving the thin membrane-like upper epidermis and veins. In badly infested plants, all the tender shoots, young fruits, and soft petioles are attacked (Viado, 1951).

The melon aphid, *Aphis gossypii*, sucks the sap of the young eggplant leaves and produces curling of the leaves.

The flea beetles, *Psylliodes balyi* and *Psylliodes splendida*, are major pests of eggplants. The larvae feed on the stems, midribs, and petioles of the host plants, and the adults, on the epidermis of the stems, leaves, buds, and flowers. The adults cut out characteristic pinholes and cause the leaves to turn yellow and drop. They sometimes prevent the plants from bearing fruits. Reveche (1922) reported that in severe cases, these insects cause complete defoliation of the plants. When no more leaves are left, the adults eat the epidermis of the stem. Reveche found that these beetles are abundant in December and January and are occasionally present from March to August, but rarely from September to November.

The leafhopper, *Empoasca flavescens*, causes serious hopperburns on the eggplant by sucking the juice of the leaves. Young plants succumb easily to its attack. Cendaña and Baltazar (1947) reported that this insect also feeds on cotton, okra, and *Solanum mammosum*.

Field tests

Phytocidal effect of the insecticidal dusts. Of the five dusts used, only Lexone showed burning effect on the leaves, flowers, and stems of both the tomato and the eggplant. Marlite, Deenate, Alorco cryolite, and calcium arsenate did not affect any part of the plants. Preliminary tests conducted by Fennah (1945) in the Lesser Antilles

showed that 10 per cent DDT dust and 5 per cent DDT spray did not injure the leaves of tomato and eggplant. Hely (1949) stated that 1 to 2 per cent DDT dusts should not be used on young tomato plants less than one foot high because they tend to burn the leaves. In the present study, no scorching effect was noted even with a 10 per cent dust, probably because the plants dusted were already at the bearing age.

Tomato fruits dusted with Lexone had a slightly different taste than the undusted fruits. A change in the flavor of tomatoes treated with technical BHC was reported by Rodriguez and Gould (1950).

On tomatoes. The results of the field tests on the tomato fruitworm are shown in table 1. Based on the percentages of damaged fruits in the dusted plants and in the untreated plants, Deenate apparently reduced the infestation by 11.5 per cent; Marlate, by 8.1 per cent; Alorco cryolite, by 6.0 per cent; calcium arsenate, by 5.9 per cent; and Lexone, by 5.7 per cent.

The average number of fruits to a plant increased with the application of the dusts. An average increase of 4.6 fruits was observed in the plants dusted with Deenate; 4.4 in those dusted with Marlate; 4.0 in those dusted with Lexone; 1.5 in those dusted with calcium arsenate; and 0.6 in those dusted with Alorco cryolite.

The average weight of each fruit also increased with the application of the dusts, the increase ranging from 1.3 to 4.5 grams. As compared with the fruits of undusted plants, the Deenate-dusted plants, with an average increase of 4.5 grams to a fruit, yielded the biggest fruits. The increases for the other insecticides were as follows: Marlate, 3.7 grams; calcium arsenate, 3.1 grams; Lexone, 1.4 grams; and Alorco cryolite, 1.3 grams.

Based on the yield in grams of a plant, the Deenate-dusted plants gave the highest increase, 206.3 grams. The increases corresponding to the other insecticides were as follows: Marlate, 195.4 grams; Lexone, 133.9 grams; calcium arsenate, 68.8 grams; and Alorco cryolite, 29.2 grams.

On the basis of the number, weight, and size of the fruits, dusting tomato plants with Deenate reduced fruitworm infestation and increased the yield most. Alorco cryolite gave the lowest values. Only Lexone, of the insecticides used, showed some phytocidal effects on the tomato plants.

On eggplants. The comparative effects of the five insecticidal dusts on the production of fruits are shown in table 2. Except for the Deenate-treated plants, there seemed to be no difference between the treated and the untreated plants. The Deenate-treated plants produced not only more but larger fruits to a plant than the control.

The infestations of flea beetles and leafhoppers on the control and on the plants before treatment were heavy as compared with those on the treated plants 24 hours after treatment. Many dead flea beetles and leafhoppers were noted on the ground under the

treated plants. Marlate, Lexone, and Deenate effectively reduced the infestations of flea beetles, leafhoppers, and *Epilachna*. Lexone, however, was the best against the flea beetles, leafhoppers, and aphids, and Deenate against the larvae and adults of *Epilachna*. Alorco cryolite and calcium arsenate were not very effective; the insects remained fairly abundant and inflicted moderate damage after application.

Lexone was the only insecticide which reduced infestation of *Aphis gossypii*. Almost complete control of this insect on cotton in South Carolina, with the use of BHC dust containing 1 to 5.75 per cent gamma isomer, was reported by Rainwater and Bondy (1947). BHC dust containing at least 5 per cent gamma isomer was found by Ewing, Parencia, and Ivy (1947) to control *Aphis gossypii* on cotton. On the other hand, Gaines and Dean (1947) reported the increase of this insect on plants treated with DDT and calcium arsenate.

The tomato plants planted side by side with the eggplants had heavier infestations of the larvae and adults of *Epilachna*, which seems to indicate that the tomato is a more favored host than the eggplant. The fruitworm attacked the control tomato plants moderately. The Deenate-treated plants were slightly infested with fruitworm; so were the plants treated with Marlate and Lexone. The *Epilachna* on tomatoes was best controlled by Deenate. Cryolite and calcium arsenate were ineffective against the fruitworm but reduced infestation of *Epilachna* from heavy to moderate. Very few red spiders were found so that it was difficult to determine the effect of the insecticides on them.

Laboratory tests

On tomato fruitworm. The results of the laboratory tests comparing the effectiveness of the insecticides against the tomato fruitworm are summarized in table 3a. The five insecticidal dusts killed the fruitworm at varying lengths of time. A complete kill was observed with Marlate, Lexone, and Deenate after 48 hours. Because of the slow killing effect of calcium arsenate and cryolite, the larvae had a chance to bore into the fruits and feed on them. On the other hand, the fruits treated with Marlate, Lexone, and Deenate were left whole because of the repellent action of the insecticides.

On larvae of Epilachna. The observations for the two tests on the second-, third-, and fourth-instar larvae of *Epilachna philippinensis* are summarized in tables 3a and 3b. The results of the two tests were similar, except that the killing time of Deenate and Marlate in the second test was shorter by 24 hours. In the case of Alorco cryolite, however, the larvae were killed 24 hours longer in the second test than in the first. The larvae fed on both the treated and untreated leaves, but fed more on the untreated.

On adult Epilachna. The results of the laboratory tests on the adults of *Epilachna* are presented in tables 3a and 3b. Calcium ar-

senate and Alorco cryolite appeared to have no repellent effect on the insects since the treated and untreated leaves were both eaten.

In the second test, 30 beetles were used. Almost identical results were obtained. It was observed that Deenate killed the most number of insects 24 hours after treatment, followed by Marlate, Lexone, and calcium arsenate. In both tests, cryolite did not kill any insect in 24 hours.

On flea beetles. The results of the tests on flea beetles are shown in tables 3a and 3b.

On leafhoppers. The results of the tests on leafhoppers are given in table 3b. Marlate and Lexone were repellent to the hoppers; Deenate was slightly repellent; and cryolite and calcium arsenate, not at all. While no attempt is made to explain the apparent toxicity of calcium arsenate to the leafhoppers, it is quite probable that the effect is physical, rather than chemical, in nature. Even dust diluents and carriers are toxic to some insects (Hunt, 1947).

Cost of insecticidal dusts

Table 4 shows the results of a survey of the costs of the insecticides in December, 1950, when they were purchased.

SUMMARY

1. Lexone was the only insecticide that had a burning effect on the leaves, flowers, and stems of eggplants and tomatoes, the burns being severer on eggplants than on tomatoes.

2. Deenate was the best for reducing fruitworm infestation on tomato and increasing the number, weight, and size of the fruits. Marlate came a close second. For reducing fruitworm infestation alone, Deenate was the best, followed by Marlate. Cryolite, calcium arsenate, and Lexone had about the same efficacy. For increasing the number of fruits, Marlate was next to Deenate in effectiveness, followed by Lexone, calcium arsenate, and cryolite. For increasing the size and weight of the fruit, Marlate was next to Deenate, followed by calcium arsenate. Lexone and cryolite had about the same effect.

3. Deenate gave the highest average weight of fruits to a plant, followed by Marlate and calcium arsenate. Lexone, probably because of its burning effect, gave the lowest value, even lower than that of the control plants.

4. On eggplants, Lexone gave the best field control of flea beetles, leafhoppers, and aphids, and Deenate, on the larvae and adults of *Epilachna*.

5. On tomatoes, Deenate gave the best field control of the fruitworm and the larvae and adults of *Epilachna*.

6. In the laboratory tests, Marlate, Lexone, and Deenate gave the best results, their killing effects on the tomato fruitworm being about the same. Deenate showed the quickest kill on the larvae and

the adults of *Epilachna*, whereas Lexone had the best killing effect on the flea beetles and the leafhoppers. Cryolite, in all the tests, had the slowest killing effect.

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TABLE 1
*Relative efficacy of five insecticidal dusts in the control of tomato fruitworm
 (Field test conducted from December, 1950, to April, 1951)*

INSECTICIDE	TREATMENT	NUMBER OF PLANTS	TOTAL NO. OF FRUITS HARVESTED	TOTAL NO. OF DAMAGED FRUITS	PERCENT- AGE OF DAMAGED FRUITS	TOTAL WEIGHT OF FRUITS <i>kg.</i>	AVERAGE NO. OF FRUITS TO A PLANT	AVERAGE WEIGHT OF EACH FRUIT <i>grams</i>	AVERAGE WEIGHT OF FRUITS TO A PLANT <i>grams</i>
Marlate	Treated	46	505	25	5.0	19.5	11.0	38.7	424.8
	Control	77	504	66	13.1	17.7	6.6	35.0	229.4
Lexone	Treated	49	445	25	5.6	15.2	9.1	34.1	309.5
	Control	56	284	32	11.3	9.3	5.1	32.7	165.6
Deenate	Treated	43	479	18	3.8	18.3	11.1	38.2	426.0
	Control	67	437	67	15.3	14.7	6.5	33.7	219.7
Alorco cryolite	Treated	65	449	40	8.9	16.0	6.9	35.7	246.8
	Control	69	436	65	14.9	15.0	6.3	32.8	217.6
Calcium arsenate	Treated	61	431	28	6.5	15.5	7.1	34.4	253.5
	Control	67	378	47	12.4	12.4	5.6	35.9	184.7

TABLE 2

*Comparative effects of five insecticidal dusts on the yield of eggplants, based on
50 plants in each treatment
(Field test conducted from May to September, 1951)*

INSECTICIDE	TREATMENT	TOTAL NO. OF FRUITS HARVESTED	TOTAL WEIGHT OF FRUITS HARVESTED	AVERAGE NO. OF FRUITS TO A PLANT	AVERAGE WEIGHT OF EACH FRUIT	AVERAGE WEIGHT OF FRUITS TO A PLANT
			<i>kg.</i>		<i>grams</i>	<i>grams</i>
Marlate	Treated	198	25.1	4.0	126.8	502.0
	Control	203	23.8	4.1	117.2	476.0
Lexone	Treated	186	23.4	3.7	125.8	468.0
	Control	192	24.2	3.8	126.0	484.0
Deenate	Treated	216	27.3	4.3	123.4	546.0
	Control	186	22.7	3.7	122.0	454.0
Alorco cryolite	Treated	204	24.5	4.1	120.1	490.0
	Control	202	24.5	4.0	121.3	490.0
Calcium arsenate	Treated	214	26.4	4.3	123.4	528.0
	Control	209	25.2	4.2	120.6	504.0

TABLE 3a
Comparative effects of five insecticidal dusts on some insect pests affecting eggplants and tomatoes^a
(Laboratory tests conducted January, February, and March, 1951)

INSECTICIDE	TEST INSECT	NUMBER OF INDIVIDUALS	NUMBER OF INSECTS KILLED AFTER SPECIFIED NUMBER OF HOURS						REMARKS
			24	48	72	96	120	144	
Marlate	<i>H. armigera</i> larvae	10	5	10					Did not feed on treated fruits
	<i>E. philippinensis</i> larvae	20	5	11					Fed on treated leaves
	<i>E. philippinensis</i> adults	15	6	11		20			Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	30	29	30					Did not feed on treated leaves
Lexone	<i>H. armigera</i> larvae	10	6	10					Did not feed on treated fruits
	<i>E. philippinensis</i> larvae	20	5	12					Fed on treated leaves
	<i>E. philippinensis</i> adults	15	5		16	20			Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	30	30	9	15				Did not feed on treated leaves
Deenate	<i>H. armigera</i> larvae	10	5	10					Did not feed on treated fruits
	<i>E. philippinensis</i> larvae	20	9	16	20				Fed on treated leaves
	<i>E. philippinensis</i> adults	15	9	15					Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	30	27	30					Fed on treated leaves
Alorco cryolite	<i>H. armigera</i> larvae	10	0	2	6	10			Fed on treated fruits
	<i>E. philippinensis</i> larvae	20	1	6	9	14	17	20	Fed on treated leaves
	<i>E. philippinensis</i> adults	15	0	2	3	7	12	15	Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	30	13	15	23	27	30		Fed on treated leaves
Calcium arsenate	<i>H. armigera</i> larvae	10	2	6	10				Fed on treated fruits
	<i>E. philippinensis</i> larvae	20	3	9	12				Fed on treated leaves
	<i>E. philippinensis</i> adults	15	1	5	11	16	20		Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	30	16	18	25	15			Fed on treated leaves

^a In all the controls not a single insect died during the tests.

TABLE 3b
Comparative effects of five insecticidal dusts on some insect pests affecting eggplants and tomatoes^a
(Laboratory tests conducted July, August, and September, 1951)

INSECTICIDE	TEST INSECT	NUMBER OF INDIVIDUALS	NUMBER OF INSECTS KILLED AFTER SPECIFIED NUMBER OF HOURS							REMARKS
			24	48	72	96	120	144	168	
Malate	<i>E. philippinensis</i> larvae	30	11	22	30					Fed on treated leaves
	<i>E. philippinensis</i> adults	30	14	19	30					Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	45	41	45						Did not feed on treated leaves
	<i>E. flavescens</i> nymphs, adults	30	30							Did not feed on treated leaves
Lexone	<i>E. philippinensis</i> larvae	30	8	16	27	30				Fed on treated leaves
	<i>E. philippinensis</i> adults	30	7	14	23	30				Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	45	45							Did not feed on treated leaves
	<i>E. flavescens</i> nymphs, adults	30	30							Did not feed on treated leaves
Deenate	<i>E. philippinensis</i> larvae	30	22	30						Fed on treated leaves
	<i>E. philippinensis</i> adults	30	22	29	30					Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	45	40	45						Fed on treated leaves
	<i>E. flavescens</i> nymphs, adults	30	30							Did not feed on treated leaves
Alorco cryolite	<i>E. philippinensis</i> larvae	30	0	0	4	11	20	27	30	Fed on treated leaves
	<i>E. philippinensis</i> adults	30	0	0	5	12	26	30		Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	45	0	14	24	34	42	44	45	Fed on treated leaves
	<i>E. flavescens</i> nymphs, adults	30	29	30						Fed on treated leaves
Calcium arsenate	<i>E. philippinensis</i> larvae	30	0	3	10	23	30			Fed on treated leaves
	<i>E. philippinensis</i> adults	30	2	8	14	27	30			Fed on treated leaves
	<i>P. splendida</i> and <i>P. balyi</i> adults	45	23	36	42	45				Fed on treated leaves
	<i>E. flavescens</i> nymphs, adults	30	22	28	30					Fed on treated leaves

^a In all the controls not a single insect died during the tests.

TABLE 4
Comparative costs of insecticidal dusts

INSECTICIDE	PERCENTAGE OF ACTIVE INGREDIENTS PRESENT	DEALER'S PRICE A POUND OR 453.6 GRAMS (DECEMBER, 1950)	COST OF CON- CENTRATE TO MAKE A POUND OF 10% DUST	COST OF 10% DUST APPLIED AT THE RATE OF 50 LBS. (22.7 KG.) TO A HECTARE FOR EVERY DUSTING
Marlate	50% methoxychlor	<i>pesos</i> 3.25	<i>pesos</i> 0.65	<i>pesos</i> 32.50
Lexone	50% benzene hexachlor- ide with 10% gamma isomer	2.20	0.44	22.00
Deenate	10% DDT	0.80	0.80	40.00
Alorco cryolite	90% sodium fluoalumi- nate	1.10	0.12	6.00
Calcium arsenate	40% arsenic pentoxide	0.75	0.19	9.50

RETAILING OF FRESH FRUITS AND VEGETABLES IN THE PUBLIC MARKET OF CAVITE CITY ¹

N. B. TABLANTE AND E. E. TIRONA

An understanding of the retail-market situation of fresh fruits and vegetables is important in establishing closer and profitable relationships between farm producers and retail outlets, on the one hand, and between retailers and consumers on the other. The retailers will know the kind and quality of products consumers want to buy, as well as the prices they are willing to pay. This information, in turn, will help the producers to determine what to supply the retailers.

The present investigation was undertaken in the city of Cavite from January, 1950, to February, 1951, to determine the kinds, quality, and prices of fresh fruits and vegetables sold at retail in the public market of the city and to know the problems connected with the retailing of these products.

The public market of Cavite City, which supplies the foodstuff of the city's 35,053 people,² in addition to the population of the neighboring towns of Noveleta and Kawit, was chosen as the place for the study because it is considered the largest market center of the province. The public market in the Philippines is the most common source of foodstuff purchased at retail by consumers, according to Tablante.³

PROCEDURE

Fifty retailers of locally grown fresh fruits and vegetables with permanent stalls in the public market of the city of Cavite were interviewed weekly for one year. With the use of mimeographed copies of a questionnaire prepared in the Department of Agricultural Economics, information about the kinds, sources, retail prices, quantities, frequency of change of stock, and rate of spoilage of fruits and vegetables was obtained from the retailers and from the vendors with temporary stands within the market place. Other facts pertaining to the retailing of these products were also gathered. Actual transactions were observed to verify the prices that consumers paid for a given quantity of a fruit or vegetable.

¹ Central Experiment Station Contribution No. 1634. Based on the thesis presented for graduation by the junior author with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Economics under the direction of the senior author.

² Bureau of the Census and Statistics. October 1, 1948. Population of the Philippines. Special Bulletin No. 1: 10.

³ TABLANTE, N. B. 1950. Retail outlets for the farmers' products. *Agricultural and Industrial Life* 12 (10): 20-21.

FINDINGS AND DISCUSSION

*Kinds and quantities of fresh fruits and vegetables handled.*⁴

The most common Philippine vegetables had a fairly good coverage in the public market of the city of Cavite. During the year 1950, the average retailer carried in stock a total of 56 kinds of fresh vegetables grouped into three kinds of flowers or shoots, 16 of fruits, 18 of leaves and tops, 10 of roots, tubers, or bulbs, and nine of legumes (table 1). Of these vegetables, 25 were available throughout the year. The average number of kinds available varied from 34 for the month of May to 49 for November. There were relatively fewer kinds during the rainy season. The quantities of those varieties which were carried in stock throughout the year varied.

Fewer kinds of fruits than vegetables (table 2) were found in the market. For the entire year, 35 kinds of fruits were handled, of which only bananas, kalamondin, guava, kamias, and papaya were available throughout. Many of the fruits were handled at certain seasons of the year and were found in the market only seven months at most. The greatest coverage of fruits was in August, when 24 kinds were on hand, and the least, in November, when 14 were available. Apparently, the season for fruits was the third quarter of the year, and that for vegetables, the last quarter, particularly November, in which month the fruits were fewest. Atis, breadfruit, avocado, lime, makopa, mango, and pineapple were in season in mid-year until the third quarter. Canistel, or tiesa, cashew, chico, duhat, kamanchile, jujube, star apple, and tamarind could be had during the first six months of the year, and guayabano, chico, lanzones, mabolo, and citrus fruits, in the latter part of the year.

The variation in quantity each month of the commodities reflected the seasonal nature of production. The same pattern of distribution was generally followed for fruits and vegetables. The quantity of vegetables handled fluctuated more than that of fruits, and generally, this fluctuation each month was wider in the more perishable kinds of either fruits or vegetables.

Sources and market outlets. Slightly less than two-thirds of all the kinds of fresh vegetables and fruits marketed in the city of Cavite came from the upland towns of the province, namely, Amadeo, Alfonso, Indang, Mendez, and Silang. These towns constitute the center of agricultural production in the province, and as such, they supply the different markets of Cavite and of other provinces with farm products. Proximity to consumption centers afforded by good roads and easy means of transportation contribute greatly to their being important sources of a variety of food commodities.

Garlic and onions were supplied by the province of Batangas, specifically, the town of Tanauan. Temperate vegetables, such as cabbage, carrot, cauliflower, and celery, came from Baguio. Most

⁴ For the scientific names of some of the fruits and vegetables, please refer to appendices A and B.

of the leafy kinds of vegetables, such as "kinchay", chive, lettuce, mustard, and pe-tsai, as well as sweet pepper and kondol, came from Manila which, in turn, drew its supply from its suburbs, particularly Navotas, Rizal. The city itself and the neighboring towns were also important sources of minor vegetable crops. The supply of melon and watermelon came from Sta. Maria, Bulacan, rather than from Alabang, Muntinglupa, Rizal.

Laguna supplied the lanzones fruit, and Batangas all the citrus fruits. Bananas, atis, avocado, jakfruit, papaya, and pineapple were drawn from the upland towns of Cavite, and mango and chico, from Imus. These commodities were transported from their respective sources by trucks.

Inquiries made with the wholesalers who regularly supply the retailers of the Cavite market revealed that a large number of outlets other than the city's public market were supplied by them. Retailers of other towns in the province, as well as those of Rizal and Laguna, and small stores in the vicinity of the production centers ordinarily got their stock from these wholesalers, some of whom were the producers themselves. Occasionally, deliveries were made direct to the homes of nearby consumers. In some instances, these wholesale buyers were jobbers who bought from the producers and resold the products to small wholesalers who, in turn, supplied the retailers catering to the needs of the final consumer. Only a few farmers sold directly to the consumers since producers were usually not in a position to attend to the specialized functions of the market channels. It may be inferred, however, that as long as the proximity of the retail outlets warrants direct sales, or at least a minimum of middleman intervention, this type of distribution may be used to advantage by the producers concerned.

Quality of products sold. In the absence of established and recognized standards, an arbitrary subjective classification of fruits and vegetables into different grades was made to determine the comparative quality of the products sold. For vegetables, the bases used were general appearance, soundness, or absence of blemish caused by rough handling or improper packing, freshness, and size; for fruits, general appearance, degree of ripeness or maturity, size, uniformity of shape and color, absence of mechanical injuries on the surface, and relative freshness. With these criteria, it was observed that a large portion of the fresh vegetables and fruits marketed in Cavite were of fair to good quality. Even on the first day the products were brought to the market, very few could be classified as excellent in quality, mainly because of careless handling, lack of proper crating or packing, and difficulty of transit. Only those commodities which were produced near the city and which could stand long-distance transporting and rough handling could be classed as excellent, and they remained in this classification for only one or two days.

The keeping quality of perishables varied greatly. The range for fruits was from two days, as in the case of caimito, chico, kamanchile, cashew, avocado, and atis, to 12 days, as in the case of most varieties of the citrus family. The more perishable kinds easily fell under the lower grades after such periods. For vegetables, the range was from one day for the leafy kinds, such as pe-tsai, lettuce, mustard, and malunggay, to three to six months for dry ones like mungo and garlic. Products which had lost their freshness but were still edible were usually sold at lower prices. The rate of spoilage of vegetables ranged from one to five per cent of each week's supply, that is, for every 10 kilos, the spoilage was from 0.1 to 0.5 kilogram.

The stock of fresh products, particularly vegetables, was replenished twice a week. Deliveries of fresh stock were usually made on Wednesday and Saturday, Sunday being the principal market day of the city. Although large-scale changes were made on the supply during these two days, the different kinds of available fruits and vegetables were carried in stock every day of the week, but these were of course of lower quality than the newly delivered ones.

Proper storage facilities were lacking or totally non-existent. Cooperative refrigeration, in which the costs of operation and maintenance are prorated among the different retailers who subscribe to it, may be suggested, but the volume of business of these retailers does not warrant economical operation of the system. Furthermore, the consumers would probably prefer the genuinely fresh products to the refrigerated ones. The retailers should try to minimize exposure of the perishables and wholesalers should provide proper containers so as to reduce injury from handling and transit.

Variation in prices. The average retail prices of vegetables and fruits did not remain constant throughout the year; they fluctuated from month to month and from season to season, being relatively higher during the early and later parts of the season. The prices of vegetables were generally low during the first three months of the year, as well as in September and October, and high from April to July and in November. On the other hand, fruits were generally priced high in February, March, August, and September and low from April to June and in November and December.

The coefficient of average seasonal price fluctuation was used to measure the amplitude of seasonal price movements. This is derived as a percentage by dividing the difference between the highest and the lowest average monthly price by the average of the two prices. On the average, the prices of vegetables fluctuated slightly more than those of fruits, the coefficients being 56 and 50 per cent, respectively.

In amplitude of seasonal price movements, the first ten ranking vegetables and fruits, with their respective percentages of coefficient, were patani (115.8), sitao (115.8), melon (113.1), carrot (104.3), lettuce (100.6), kamanchile (100.0), green tamarind (100.0),

mungo sprout (97.8), pe-tsai (94.2), and calamondin (92.3). The commodities with wide seasonal price variations were the more perishable or seasonal kinds. This observation corroborates the finding of Shepherd⁵ that the "prices of perishable crops can be expected to fluctuate seasonally more than the prices of the more durable (storable) crops."

Small retailers who had no permanent stalls and who occasionally sold small quantities of fruits and/or vegetables generally charged lower prices than those who sold them regularly since their overhead was comparatively low. Many of these occasional sellers were themselves the producers of their commodities and could, therefore, afford to dispose of their products at small margins.

Compared with the prices of fruits and vegetables in the city of Manila as reported by the Bureau of Commerce, the prices of similar products in the city of Cavite for the same year were generally lower. Except for Bungulan and Lacatan bananas and those vegetables grown near Manila, such as pe-tsai, mustard, and cabbage, prices of fruits and vegetables were slightly higher in Manila than in Cavite. The reason for this is that Cavite is nearer the regions of agricultural production than Manila so that the supply is greater and the products are transported over shorter distances. Although the prices in the two cities differed slightly, the pattern of seasonal fluctuation was practically similar.

The seasonal behavior of the prices of fruits and vegetables may be largely explained by the effects of the forces of supply and demand. When the supply was great and the demand assumed to be constant, the price was generally low, and vice versa. When the demand was great in relation to the supply, as on the "fiesta" in November and during the Christmas season, the prices were high. Certain commodities were generally sold at the same price throughout the year because of the prevalence of customary prices and government-specified prices.

SUMMARY

1. In the public market of the city of Cavite, 56 kinds of vegetables and 35 of fruits were handled by the retailers in 1950. Of these, 25 vegetables and 8 fruits were available in the market through the entire year. The least number of kinds of vegetables was sold in May, and that of fruits, in November. The greatest coverage for vegetables was in November and for fruits, in August.

2. The more important vegetables which were available from January to December, inclusive, were cabbage, pe-tsai, mustard, eggplant, ampalaya, pepper, squash, upo, chayote, garlic, and onions. Bananas, calamondin, guava, kamias and papaya were the fruits in the market throughout the year. Melon and watermelon were in season during the summer months. Atis, avocado, mango, and pine-

⁵ SHEPHERD, G. S. 1941. *Agricultural price analysis*. viii + 402 p. Ames, Iowa: The Iowa State College Press.

apple were available during the second and third quarters of the year; and guayabano, chico, lanzones, and citrus fruits, in the later part of the year.

3. The quantities and retail prices of vegetables handled fluctuated more than those of fruits. The more perishable and seasonal kinds exhibited wider variations for each month.

4. Most of the fruits and vegetables came from the highland towns of the province, namely, Amadeo, Alfonso, Mendez, Silang, and Indang. Other important sources of supply were Rizal, Laguna, Batangas, Manila, Baguio, Bulacan, and the neighboring towns of the city. Wholesale buyers generally supplied the retailers with the different commodities.

5. The fruits and vegetables marketed in the city were commonly of fair to good quality. The average keeping quality ranged from one day to three to six months, depending upon the nature of the commodity. The rate of spoilage of vegetables was from one to five per cent of the total supply for a week.

6. Prices were generally influenced by conditions of demand and supply, custom, and government regulations. The prices of vegetables were generally high from April to July and in November and low during the first quarter of the year; those of fruits were low in the second and fourth quarters and high in the first and third quarters.

7. Prices in the city of Cavite were generally lower than those prevailing in Manila for similar commodities, the slight difference being attributable to differences in transportation cost as a result of the nearness of Cavite to production centers.

8. Retailers who did not have permanent stalls usually sold their products at slightly lower prices than those who paid fixed rentals for stall space.

9. Lack of proper storage facilities was one of the most important problems in retailing fruits and vegetables in this city.

APPENDIX A

Some important Philippine vegetables

Ampalaya, *Momordica charantia* Linn.
 Upo, *Lagenaria leucantha* (Duch.) Rusby
 Chayote, *Sechium edule* (Jacq.) Sw.
 Kondol, *Benincasa hispida* (Thunb.) Cogn.
 Okra, *Hibiscus esculentus* Linn.
 Pepper, sweet, *Capsicum frutescens* Linn. var. *grossum*
 Pepper, long, *Capsicum frutescens* Linn. var. *longum*
 Pepper, "labuyo", *Capsicum frutescens* Linn. var. *faciculatum*
 Patola, *Luffa cylindrica* Linn. and *L. acutangula* Linn.
 Celery, *Apium graveolens* Linn. var. *dulce*
 Chive ("kuchay"), *Allium porrum* Linn.
 Coriander ("unsoy"), *Coriandrum sativum* Linn.
 Kangkong, *Ipomoea reptans* (Linn.) Poir.
 Kinchay, *Apium graveolens* Linn.
 Kulitis, *Amaranthus viridis* Linn.

Malunggay, *Moringa oleifera* (Linn.) Lam.
 Pe-tsai, *Brassica pekinensis* (Lour.) Rupr.
 Gabi, *Colocasia esculentum* (Linn.) Schott, *C. antiquorum* Schott
 Onion, multiplier, *Allium cepa* Linn. var. *solanium*
 Onion, Bermuda, *Allium cepa* Linn.
 Radish, *Raphanus sativus* Linn. var. *longipinnatus*
 Singkamas, *Pachyrrhizus erosus* (Linn.) Urb.
 Tugui, *Dioscorea esculenta* (Lour.) Burkill
 Yautia, *Xanthosoma sagittifolium* Schott
 Bataw, *Dolichos lablab* Linn.
 Cowpea ("paayap"), *Vigna sinensis* (Linn.) Endl.
 Habichuelas, *Phaseolus vulgaris* Linn.
 Kalamismis, *Psophocarpus tetragonolobus* (Linn.) D. C.
 Mungo, *Phaseolus aureus* Roxb.
 Patani, *Phaseolus lunatus* Linn.
 Pea ("chicharo"), *Pisum sativum* Linn. var. *macrocarpon*
 Sitao, *Vigna sesquipedalis* W. F. Wight

APPENDIX B

Some important Philippine fruits

Atis, *Annona squamosa* Linn.
 Avocado, *Persea americana* Mill.
 Banana:
 Buñgulan, *Musa sapientum* Linn. var. *suaveolens* (Blanco) Teodoro
 Lacatan, *Musa sapientum* Linn. var. *lacatan* (Blanco) Teodoro
 Latundan, *Musa sapientum* Linn. var. *cinerea* (Blanco) Teodoro
 Saba, *Musa sapientum* Linn. var. *compressa* (Blanco) Teodoro
 Balimbing, *Averrhoa carambola* Linn.
 Breadfruit ("rimas"), *Artocarpus communis* Forst.
 Calamondin, *Citrus microcarpia* (Linn.) Bunge
 Canistel (tiesa), *Lucuma nervosa* A. DC.
 Cashew, *Anacardium occidentale* Linn.
 Chico, *Achras zapota* Linn.
 Duhát, *Syzygium cumini* (Linn.) Skeels
 Guava, *Psidium guajava* Linn.
 Guayabano, *Annona muricata* Linn.
 Jakfruit, *Artocarpus heterophyllus* Lam.
 Jujube, *Zyzyphus jujuba* (Linn.) Lam.
 Kamanchile, *Pithecolobium dulce* (Roxb.) Benth.
 Kamias, *Averrhoa bilimbi* Linn.
 Lanzones, *Lansium domesticum* Jack.
 Lime ("dayap"), *Citrus aurantifolia* (Christmann) Sw.
 Mabolo, *Diospyros discolor* Willd.
 Makopa, *Syzygium samarangense* (Blume) Merr. & Perry
 Mandarin (naranjita), *Citrus nobilis* Lour.
 Mango, *Mangifera indica* Linn.
 Papaya, *Carica papaya* Linn.
 Pummelo, *Citrus grandis* (Linn.) Osbeck
 Santol, *Sandoricum koetjape* (Burm. f.) Merr.
 Star apple, *Chrysophyllum cainito* Linn.
 Siniguelas, *Spondias purpurea* Linn.
 Tamarind, *Tamarindus indica* Linn.

TABLE 1
Average retail prices of different kinds of vegetables, city of Cavite, 1950

COMMODITY	NUMBER OF MONTHS AVAIL- ABLE	UNIT	RETAIL PRICES			COEFFI- CIENT OF AVERAGE SEA- SONAL FLUC- TUATION
			Mini- mum	Maxi- mum	Average	
			centavos	centavos	centavos	per cent
Vegetables: flowers and shoots						
Banana "heart"	12	each	13.7	22.5	17.4	48.1
Cauliflower	7	kilogram	195.0	380.5	243.5	64.5
Bamboo shoot ("labong")	4	each	37.4	47.5	41.1	23.8
Vegetables: fruits						
Ampalaya	12	kilogram	32.5	47.5	38.3	37.5
Upo	12	each	28.7	39.9	35.5	32.6
Chayote	12	kilogram	22.5	36.5	28.5	47.5
Cucumber	8	each	12.5	23.1	16.9	59.5
Eggplant	12	each	2.9	7.5	4.9	88.5
Kondol	7	each	118.5	162.5	136.5	32.4
Melon	4	each	12.5	45.0	28.5	113.1
Okra	6	each	0.4	0.8	0.7	70.0
Papaya, green ^a	12	each	3.8	6.0	4.8	22.4
Pepper, sweet	12	kilogram	55.0	102.5	76.8	60.3
Pepper, native, long	12	each	1.3	1.9	1.5	36.7
Patola	6	each	12.5	22.5	18.2	57.1
Squash	12	each	40.0	60.0	50.6	40.0
Tomato, native, large	6	kilogram	75.0	125.0	95.6	50.0
Tomato, "wild"	9	kilogram	28.8	47.5	37.7	48.9
Watermelon	4	each	38.8	95.0	59.9	84.0
Vegetables: leaves						
Ampalaya	11	bundle	4.5	9.0	7.1	66.7
Cabbage	12	kilogram	41.2	77.5	59.1	61.1
Celery	7	kilogram	216.5	390.0	283.5	57.2
Chive ("kuchay")	12	kilogram	27.5	45.0	36.5	48.3
Coriander ("unsoy")	2	bundle	4.2	4.5	4.3	7.0
Garlic, young leaves	3	each	0.9	1.5	1.3	47.4
Kangkong	12	bundle	4.0	10.0	5.8	85.7
Kinchay	12	kilogram	55.0	112.5	80.9	68.2
Kulitis	3	bundle	5.9	8.4	6.9	34.9
Lettuce	12	kilogram	25.0	75.6	49.0	100.6
Malunggay	5	bundle	4.0	7.5	5.9	60.9
Mustard	12	kilogram	32.5	66.5	54.2	68.7
Onion, green	12	kilogram	46.3	105.0	74.9	77.6
Pe-tsai	12	kilogram	26.9	75.6	48.8	94.2
Pepper, "labuyo"	6	bundle	3.5	4.3	3.9	20.5
Squash	6	bundle	4.3	7.0	5.7	47.8
Sweet potato	12	bundle	3.5	6.0	4.7	52.6
Tamarind	6	bundle	3.5	5.3	4.2	40.9
Vegetables: roots, tubers, bulbs						
Carrot	8	kilogram	122.5	390.0	233.0	104.3
Gabi	6	kilogram	20.0	27.5	23.7	32.0
Garlic	12	kilogram	62.5	95.3	71.0	41.5
Onion, multiplier	12	kilogram	75.6	108.0	91.2	35.3
Onion, Bermuda	12	kilogram	45.0	55.6	47.3	21.1
Radish	8	each	3.5	6.5	4.8	57.4
Singkamas	5	bundle	7.3	13.5	10.7	59.6

TABLE 1 (continued)

COMMODITY	NUMBER OF MONTHS AVAIL- ABLE	UNIT	RETAIL PRICES			COEFFI- CIENT OF AVERAGE SEA- SONAL FLUC- TUATION
			Mini- mum	Maxi- mum	Average	
Sweet potato	12	kilogram	12.5	25.0	17.7	66.7
Tugui	5	kilogram	22.5	27.5	25.7	20.0
Yautia	12	kilogram	31.2	45.0	37.8	36.2
Vegetables: legumes						
Bataw	5	each	0.5	1.1	0.9	75.0
Cowpea ("paayap")	6	bundle	6.4	17.2	12.3	53.0
Habichuelas	7	kilogram	32.5	47.5	40.7	37.5
Kalamismis	8	each	0.7	1.5	1.1	72.7
Mungo beans	12	ganta	112.5	141.5	127.0	22.9
Mungo sprout ("togue")	12	liter	6.0	17.5	9.8	97.8
Patani	8	each	0.4	1.5	0.8	115.8
Pea ("chicharo")	4	kilogram	128.0	190.0	151.5	38.3
Sitao	6	each	0.4	1.5	0.9	115.8

^a Pomologically classified as fruit but ordinarily used as vegetable.

TABLE 2

Average retail prices of different kinds of fruits, city of Cavite, 1950

COMMODITY	NUMBER OF MONTHS AVAIL- ABLE	UNIT	RETAIL PRICES			COEFFI- CIENT OF AVERAGE SEA- SONAL FLUC- TUATION
			Mini- mum	Maxi- mum	Average	
			centavos	centavos	centavos	per cent
Atis	4	each	7.4	10.0	8.3	30.0
Avocado	5	kilogram	33.8	51.3	40.2	41.1
Bananas:						
Buñgulan	12	each finger	4.5	5.3	4.9	16.3
Lacatan	12	each finger	4.8	6.5	5.6	30.1
Latundan	12	each finger	1.0	2.1	1.5	70.9
Saba	12	each finger	1.5	2.1	2.0	33.3
Balimbing	7	each	1.3	2.1	1.7	47.0
Breadfruit	3	each	15.6	23.3	19.6	38.5
Calamondin	12	each	0.7	1.9	1.2	92.3
Canistel (tiesa)	3	each	10.9	13.5	12.6	21.3
Cashew	5	each	2.6	4.5	3.6	49.2
Chico	6	each	3.7	7.8	6.0	71.3
Duhat	3	liter	7.5	10.0	9.8	46.1
Guava	12	each	0.5	1.7	1.3	83.3
Guayabano	6	each	19.5	37.5	29.1	63.2
Jakfruit	6	each	215.0	325.0	250.5	40.7
Jujube	4	each	0.3	0.4	0.4	30.0
Kamanchile	5	each	0.5	1.5	0.8	100.0
Kamias	12	each	0.7	1.7	1.2	83.3
Lanzones	5	kilogram	145.0	245.0	174.6	51.2
Lime ("dayap")	4	each	6.5	9.0	7.9	32.3
Mabolo	3	each	8.9	13.5	10.7	41.1
Makopa	2	each	1.1	1.3	1.2	16.7
Mandarin ("naranjita") ..	5	each	6.0	9.0	7.0	40.0
Mango, ripe:						
Carabao	3	each	21.3	27.5	24.4	25.4
Pico	4	each	5.8	12.1	8.3	70.4
Pahutan	5	each	2.3	4.0	3.2	54.3
Papaya, ripe	12	each	27.5	48.5	38.5	55.1
Pineapple	4	each	24.0	40.0	33.6	50.0
Pummelo	6	each	13.8	27.5	20.3	67.9
Santol	5	each	1.1	2.1	1.6	62.7
Star apple	5	each	6.8	13.3	9.7	64.2
Siniguelas	3	each	0.9	1.1	1.0	20.0
Tamarind, green	8	each	0.5	1.5	1.0	100.0
Tamarind, ripe	3	each	1.9	2.1	2.0	10.0

A SURVEY OF FARM, HOME, AND COMMUNITY CONDITIONS OF RICE FARMERS IN THE BARRIOS OF CABUYAO, LAGUNA, AS BASIS FOR FORMULATING A PROGRAM OF RURAL IMPROVEMENT ¹

FRANCISCO M. SACAY AND FABIANA E. ALVIAR

Any program of rural improvement must be based upon a thorough understanding of the conditions existing in rural farms, homes, and communities. Hence, a survey of the farm conditions, such as type of farming, size of farm, crops grown, livestock raised, and income, and the home and community conditions, such as nature of dwelling, household facilities and conveniences, educational attainment, organizational membership, and recreational activities, of the rice farmers in the barrios of Cabuyao, Laguna, was conducted from March to May, 1948.

Rice is the most important crop in the Philippines and the rice farmers constitute a large proportion of the rural population. About one-half of our farmers are engaged in rice production. Of these, the majority are tenants. One of the earliest studies on the economic and social conditions of tenant farmers was that by Hester *et al.*,² who found that the average area of a farm was 2.4 hectares; farm income, ₱189; income from secondary occupations, ₱85; and investment of a tenant, ₱345.

Arnaldo and Velmonte³ studied the rice farms of the College which were operated under the tenancy system and found that the average labor income of a tenant was only ₱41.09 for lowland rice. The low labor income was largely due to the small area operated by a tenant.

Dalisay⁴ investigated the income of tenants and the cost of production of rice in Cabiao, Nueva Ecija. He concluded that the average investment of a tenant farmer was ₱280.27; labor income, ₱101.32; cost of producing a cavan of rice, ₱2.76; and average price of a cavan, ₱3.00.

Sacay and Naanep⁵ studied the farm, home, and community conditions in a farm village of Ilocos Norte where the farmers were

¹ Central Experiment Station Contribution No. 1635.

² HESTER, EVETT D., *et al.* 1924. Some economic and social aspects of Philippine rice tenancies. *Philippine Agriculturist* 12: 357-444.

³ ARNALDO, MARCELO V., AND JOSE E. VELMONTE. 1937. A five-year farm accounting study of tenancies in the College of Agriculture Farm, 1931-1936. *Philippine Agriculturist* 30: 465-491.

⁴ DALISAY, AMANDO M. 1938. Factors related to income and cost of production of rice on tenant holdings in Cabiao, Nueva Ecija. *Philippine Agriculturist* 26: 730-756.

⁵ SACAY, F. M., AND FLORENDO R. NAANEP. 1940. A study of farm, home, and community conditions in a farm village of Ilocos Norte as a basis for formulating a program of rural education. *Philippine Agriculturist* 29: 555-570.

largely engaged in rice-growing. They reported that the farm receipts of a farm averaged ₱134.76; labor income, ₱23.30; and labor earnings, ₱155.01.

The foregoing studies were conducted before World War II. No thorough study of the economic and social conditions of rice farmers after the war has been reported.

The survey method was employed in the present investigation. Data were secured through personal interviews with the farmers, their wives, and older children and recorded in a survey form. Of the 150 farmers who were originally surveyed, 145 were tenants. Only five, or about 3 per cent, owned the farms they cultivated. The present study covers the 145 tenant-operators.

FINDINGS AND DISCUSSION

Description of the area surveyed

Cabuyao is a third-class municipality located in the northwestern part of Laguna, bordering Laguna de Bay. It is irrigated but the amount of water is not sufficient for all the farms. The barrio of Bigaa has a good irrigation system, 17 farms being provided with artesian wells. The other farms depend entirely upon rain for their water supply.

Age, birthplace, length of residence, and experience of farm operators

The ages of the farm operators ranged from 18 to 84 years, or an average of 42.2 years. About 50 per cent of the operators were from 30 to 34 years old; only 14 per cent were below 30 years.

About 79.3 per cent of the tenant-operators were born in the barrios where they were residing at the time of the survey; 15.9 per cent, in other barrios of Cabuyao; 1.4 per cent, in other towns of Laguna; 3.4 per cent, in other provinces.

The tenant-operators had lived an average of 39.1 years in the barrios where they resided. Their average length of residence in the municipality of Cabuyao was 39.2 years.

The tenants had been engaged in rice farming for an average of 19 years. About one-third of the farmers had been growing rice for 10 years or less, and about 9 per cent, for 40 to 60 years.

Farm conditions

Size of farm. The farms ranged in size from one to 11.5 hectares, or an average of 3.11 hectares. About two-thirds of the farmers operated farms of three hectares or less. Only 8.3 per cent of the farms were over five hectares in area.

Of the average farm area of 3.11 hectares, 3.05 hectares were planted to field crops. The remaining area, amounting to 1.9 per cent, was divided into farmstead, garden, and orchard.

Investment and ownership of capital. The average capital investment in a farm was ₱9,584.20, of which 87.5 per cent was invested in land. The next biggest portions were in work animals and buildings.

Of the total capital invested, ₱8,273.78 was owned by the landlord and ₱1,310.42, or 13.7 per cent, by the tenant. The landlords owned all the crop land. The operators, however, owned the lots on which their dwellings were built, the buildings, tools, and live-stock.

Crops grown and livestock raised. Rice was the principal crop grown by all the farmers. The average area planted to rice in a farm was 2.52 hectares. Sugar cane and corn were the other important crops. Fruits and vegetables were grown on a limited scale. The principal vegetables raised were watermelon, eggplant, tomato, string bean, and patola; the fruits were banana, chico, and papaya.

The work animal on the farm was the carabao. The average number to a farm was 1.69. Cattle, horses, swine, goats, chickens, and ducks were raised in limited numbers.

Farm receipts and expenses. Rice, the principal source of income, contributed 87.8 per cent to the receipts from farm crops, which averaged ₱1,227.60 to a farm. Other sources of income were corn, sugar cane, fruits, and vegetables. The receipts of a farm totalled an average of ₱1,416.66, of which 84.3 per cent came from the sale of farm crops. Receipts from the sale of vegetables, fruits, and livestock amounted to only 3.8 per cent. The gross farm income, which included farm privileges, amounted to ₱1,895.44. This income was relatively larger than the prewar income, mainly because of the high postwar price of rice. Its price index was higher than that of other commodities.

The expenses of a farm averaged ₱1,268.55. The largest item of expense was land rent, which amounted to 51.2 per cent of the whole. The other items of expense were cash expenses, harvester's share, unpaid family labor, and decrease of capital.

Labor income and family income. The labor income for each farm averaged ₱69.48. The amount was small in view of the fact that a big proportion of the rice crop was not sold but was kept for home use. About ₱406.42 worth of crops was consumed on each farm. The farm also furnished vegetables, fruits, livestock products, and the dwelling place. The total farm privileges amounted to ₱478.78.

The total family income amounted to ₱944.28, of which about 62.1 per cent was earned by the farm operator. When the unpaid family labor and interest on the operator's investment were added to the family income, there was a total of ₱1,022.91, which represented the amount available for family living. The amount available for each member of the household was ₱168.24.

Labor earnings. In view of the large proportion of the crop used at home, the labor earnings, which amounted to an average

of ₱548.26, was a better measure of the result of the farmer's work. One of the most important factors that influenced labor earnings was the crop area. The operator's labor earnings generally increased in direct proportion to the increase in rice area. The small income of the rice farmer was largely due to the limited size of the farm that he operated. Another factor that was positively correlated with labor earnings was the crop index. Farms which produced higher yield to a hectare made larger labor earnings. This shows the importance of improving the farming practices of the rice farmers.

Labor requirement and production cost of a hectare of rice. To grow and harvest one hectare of rice required 101.51 days of man labor and 28.99 days of animal labor. Harvesting in January and February entailed the largest amount of labor, 47.13 man labor days. The other operations that required much man labor were harrowing, preparing the land, transplanting, and threshing. A considerable amount of man and animal labor was needed to prepare the land in June and July. Planting in August and September also required man labor.

The production cost of a hectare of rice was ₱445.17 on the average. Of this amount, the cost of man labor was 45.0 per cent; that of the use of land was 36.3 per cent. The average yield to a hectare was 36.82 cavans of palay. This was below normal because of the poor weather conditions that prevailed during that year. The cost of producing a cavan of palay was ₱12.09 and the average selling price was ₱14.82, leaving a net gain of ₱100.50 to a hectare.

Rice-growing practices. All the farmers planted nonbearded varieties of rice. The most common varieties planted were Seraup Kechil 36, Magsalet, Quezon, Ramelon, Elon-elon, Macan, and Inadhika. The majority of the farm operators used seeds obtained from the previous harvest; a few exchanged seeds with other farmers. About 60 per cent of the operators practiced mass selection. They selected seeds from paddies with high-yielding plants.

The majority of the farmers plowed their fields once and harrowed them three times. The most common distance of planting was 20 centimeters square. The farmers used neither manure nor commercial fertilizers. Pests were controlled by draining and flooding the field. The crop was usually harvested with the use of the "yatab," and sometimes, with the "gapas" and the "alet." The harvested palay was stored in large bamboo baskets or in wooden baskets. None of the farmers employed crop rotation and green manuring, and no one kept accounting records. The rice farmers, in general, still employed antiquated methods of farming.

Home conditions

Size and type of household. The individuals in a household ranged from two to twelve, or an average of 6.08. The children comprised 57 per cent of the household members. About 16.6 per cent

of the households had relatives staying with the resident family members.

The typical household of five members made up 22.8 per cent of all the households. The family consisting of seven members constituted 15.2 per cent.

The most common type of household was composed of the husband, wife, and three children. This type made up 22.8 per cent of all the households. The husband-wife-children-relatives type comprised 16.6 per cent. The number of children ranged from one to eight, or an average of 3.46 to a household.

Type, size, and value of dwellings. The most common materials used in the construction of the dwellings were nipa for roofing and walling, wood for walling, and bamboo for flooring. About 29.6 per cent of the dwellings had wooden walls and bamboo floors. A large number had nipa roofs and walls and bamboo floors. Only 25.5 per cent of the farm dwellings had galvanized iron roofs; a few houses had cogon roofs.

The average dwelling had a floor area of 41.2 square meters, or 6.8 square meters to a person. The average number of rooms to a dwelling was 3.1, or 1.97 persons to a room.

The value of dwellings ranged from ₱50 to ₱3,000, or an average of ₱436.46. About 64.1 per cent of the dwellings were valued at ₱300 or less.

Home facilities and conveniences. The most common conveniences in the homes were wooden benches, wooden chairs, steel chairs, flatirons, dining tables, and sewing machines. Only 17.2 per cent of the homes had ground wells; a smaller number, 3.4 per cent, had wells provided with pumps. About 16.6 per cent of the homes had water containers with faucets. Only 2.1 per cent had electric lights, and only one house had running water.

Homeground beautification. A limited amount of work to beautify the homeground was done by most farmers. About three-fourths of the farmsteads had hedges on the front boundaries and almost one-half had hedges on the side boundaries. Shade trees were found in 51.7 per cent of the farmsteads. In some of the yards, potted plants were found.

Community conditions

School attendance. Of the children who were 7 to 14 years old and who lived with their parents, 60.3 per cent were attending school. The average number of grades completed was 1.8. Among the older children, especially among the girls, the percentage of attendance was very low. Among the children 15 to 24 years old, the average schooling was 3.9 years. The males completed 4.3 grades, and the females completed 3.4 grades. Very few young people reached the high school.

On the average, the tenant-operators and their wives completed 2.65 grades.

Reading matter in farm homes. The most common reading matter found in farm homes was the *Liwayway*. Other popular weeklies were the *Ilang-ilang* and the *Bulaklak*. The *Manila Times* was found in 4.8 per cent of the farm homes, and the *Manila Chronicle*, in 0.7 per cent. In 27.6 per cent of the farm homes, there was no reading matter.

Recreational activities. Going to the motion pictures appeared to be the most popular form of recreation among adults and children. Chatting was also common. Among the tenant-operators, cock-fighting was popular. Children above ten years old spent their leisure time by playing games, reading magazines, chatting with friends, playing cards, taking walks, and going to parties.

Membership in organizations. Only very few adults belonged to organizations. Of the 145 tenant-operators, 20 belonged to the Parent-Teacher Association and one to a labor organization. Only two wives were members of an organization. Among the children, several belonged to school and class organizations.

SUMMARY

1. In a survey of the farm, home, and community conditions of rice farmers in Cabuyao, Laguna, the average size of farm was found to be 3.11 hectares, of which 98.1 per cent was devoted to crops. The total investment in a farm was ₱9,584.20, of which only 13.7 per cent was owned by the tenant-operator.

2. The most important crop was rice. Limited quantities of fruits and vegetables were raised. Only a limited number of live-stock was kept, the most common being carabaos, chickens, and pigs.

3. The gross farm income amounted to ₱1,895.44; labor income, ₱69.48; labor earnings, ₱548.26; family income, ₱944.28; and amount available for family living, ₱1,022.91. The amount for family living averaged ₱168.24 for each member of the household.

4. A positive relationship existed between labor earnings and the following factors: size of farm capital, area of land planted to rice, and rice crop index.

5. The cost of producing rice from a hectare of land was ₱445.17, or ₱12.09 a cavan. The average selling price of a cavan was ₱14.82.

6. The number of individuals in a household ranged from two to twelve, or an average of 6.08.

7. The majority of the dwellings had nipa roofs and walls and bamboo floors. The farm homes had inadequate conveniences and facilities. Little interest was shown in home beautification.

8. Most of the older children had limited schooling. Reading matter in farm homes was meager and reading was indulged in by

few farm people. The most common recreational activities were going to motion pictures, chatting, and taking walks.

CONCLUSION

This survey would seem to show that the small size of farms, poor farming methods, one-crop system of farming, and low educational attainment are responsible for the small income and unsatisfactory standard of living of rice farmers. Government agencies working with farmers and rural dwellers, particularly the public schools and the agricultural extension service, must bring about desirable changes in farm, home, and community conditions if farming and farm life in our rice-producing regions are to be improved.

A STUDY OF THE ADAPTABILITY TO LOS BAÑOS CONDITIONS OF ELEVEN VARIETIES OF SOYBEAN ¹

VALERIANO C. CALMA AND CANDIDO V. ROSARIO

With the object of selecting varieties of soybean adapted to Los Baños conditions, a study of the 1947 to 1948 dry-season planting of eleven varieties and the 1948 wet-season planting of the seven highest-yielding varieties selected from the 1947-1948 dry-season culture was conducted from November, 1947, to October, 1948, in the Department of Agronomy of the College of Agriculture at Los Baños.

EXPERIMENTS AND RESULTS

The varieties obtained by the College from the United States Department of Agriculture on June 4, 1947, were used. The names and Foreign Plant Introduction Accession Numbers of eight of these varieties, which were described by Morse and Cartter,² are as follows: Arksoy, F. P. I. No. 37335; Creole, F. P. I. No. 71614; Georgian, F. P. I. No. 71583; Hongkong, F. P. I. No. 22406; Mamredo, Selection, Delta Station No. 488-607; Monetta, F. P. I. No. 71608; Nanking, F. P. I. No. 71597; Palmetto, F. P. I. No. 71587.

The land was prepared as for an ordinary crop. Of the field of clay loam in the Central Experiment Station, about 880 square meters were planted in the dry season and about 672 square meters in the wet season. Both areas had previously been planted to corn and sweet potato.

In the dry-season culture, planted on November 19, 1947, only one furrow was used for each variety because there were few seeds; in the wet-season culture, seeded on June 16, 1948, each selected variety was replicated three times, each plot having an area of 32 square meters. The plots were randomized to allow analysis of variance. Two to three seeds were planted in hills 30 centimeters apart in the furrows. To get a good stand of crop, the missing hills were replanted two weeks after seeding.

In the dry-season planting, cultivation between the hills with a hoe was made when the plants were 25 days old. This was followed two days later by the final cultivation, or hilling up, with a native plow between the furrows. Fifteen days after planting the

¹ Central Experiment Station Contribution No. 1636. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1948. Prepared in the Department of Agronomy under the direction of the senior author.

² MORSE, W. J., AND J. L. CARTTER. 1939. Soybeans Culture and varieties. U. S. D. A. Farmers' Bull. 1520: 1-39.

wet-season culture, a three-tooth cultivator was passed between the furrows to kill the weeds and break up the top soil. Weeding with a hoe was done whenever necessary. The last cultivation was done 28 days after planting.

The percentages of germination of 100 hills taken at random in each plot of the dry-season culture were as follows: Arksoy, 77; Creole, 92; Georgian, 68; Hongkong, 64; Mamredo, 80; Monetta, 86; Nanking, 85; Palmetto, 67; Pennsoy, 52; Roanoke, 66; and Seminole, 59. The percentages of stand of plants follow: Arksoy, 76; Creole, 90; Georgian, 65; Hongkong, 60; Mamredo, 70; Monetta, 84; Nanking, 81; Palmetto, 60; Pennsoy, 30; Roanoke, 36; and Seminole, 40.

The varieties of soybean studied had poor germination, probably because the soil was compacted by the heavy rain which fell three days before planting. Rodrigo³ noted that the period of germination is the most critical stage in the plant and that excessive moisture or prolonged drought is disastrous. The poor germination may also have been partly due to the long storage of the seeds. Calma, Valencia, and Tale⁴ reported that after 164 days in storage, seeds had as low a percentage of germination as 17.5. The percentage of stand of the plants in the field was, in general, very low because of the heavy rains and typhoons which occurred on December 1 and 26, 1947, respectively. The compacting of the soil and the sunny days which followed killed many of the plants.

In the wet-season crop, Nanking, Monetta, Mamredo, and Palmetto gave the highest and practically the same percentages of germination; there was no significant difference between their means. Seminole had the lowest percentages of germination and stand of plants in the field. The rest of the varieties did not differ significantly in stand of plants.

During the dry season all of the varieties were dwarfed, but in the wet season they exhibited different habits of growth. These results agree with the findings of Rodrigo⁵ that very few of the introduced varieties of soybean can be grown commercially during the dry season.

The green leaves of Palmetto, Creole, Seminole, and Nanking were intact at harvest, a point of interest to stockmen because the straw may serve as valuable animal feed. The other varieties were defoliated and only the pods were left on the stem. Palmetto and Creole were the tallest and Nanking the shortest.

³ RODRIGO, P. A. 1947. Soybean culture in the Philippines. *Philippine Jour. Agric.* 13: 1-22.

⁴ CALMA, VALERIANO C., ILUMINADO G. VALENCIA, AND J. V. TALE. 1949. Effect of mass selection of the seed and of season of planting on the yield of the soybean. *Philippine Agriculturist* 32: 313-328.

⁵ *Ibid.*

All of the eight varieties were true to the color described by Morse and Cartter,⁶ but the flowers differed slightly in shade from purple to violet. Arksoy produced white flowers instead of purple.

The seeds varied in color, size, and shape. Seminole required the least number of seeds to make a kilogram (3,207), or to make a chupa (875); Palmetto required the greatest to make a kilogram (7,728), or to make a chupa (1,997), indicating that it had the smallest seeds.

The flowering, dough, and maturity stages of the different varieties in the dry-season planting did not vary much. Seminole was the last to reach the dough and maturity stages, partly because it has comparatively much larger pods and seeds than the other varieties. The flowering of the eight varieties as reported by Morse and Cartter⁷ ranged from 65 to 100 days. In the present study, the same varieties flowered in 26 to 36 days in the dry-season culture and 36 to 44 days in the wet-season culture. In the wet-season culture, maturity was prolonged and varied from 92 to 100 days; that in the dry-season culture varied from 79 to 99 days.⁸ Creole, Palmetto, and Seminole, which matured late, also flowered late.

Neither pest nor disease attacked the dry-season planting. In the wet-season culture, however, one hill of the Monetta variety was attacked by *Prodenia litura* Fabr.⁹ on August 14, 1948. The worms were picked by hand; damage was negligible. On August 20, 1948, one hill, or 0.75 per cent, of each of the Nanking, Mamredo, and Georgian varieties in the second replication were infested with *Rhizoctonia solani* Kuhn.¹⁰ The diseased plants were pulled up, and the fallen leaves carefully gathered and burned.

There were differences in mean yield of seed and straw among the eleven varieties. The seven highest yielders of seed in descending order were Seminole, Monetta, Creole, Palmetto, Nanking, Mamredo, and Georgian.

Seminole gave the highest yield of seed in the dry-season culture. Monetta, the second ranking variety, produced more seeds than the rest of the varieties except Creole, the third ranking variety, from which its difference was insignificant. Creole, Palmetto, and Nanking had statistically the same yield of seed; each had a higher yield of seed than the rest of the varieties tested. There were no significant differences in yield of seed among Mamredo, Georgian, Arksoy, Pennoy, and Roanoke.

In yield of straw, the different varieties ranked practically in the same order as in their yield of seed; Seminole had the highest yield of straw.

⁶ *Ibid.*

⁷ *Ibid.*

⁸ Morse and Cartter (1939) noted that the eight varieties they described matured in 120 to 165 days.

⁹ The pest was identified in the Department of Entomology.

¹⁰ The disease was identified in the Department of Plant Pathology.

The results of the wet-season culture showed highly significant differences in yield of seed and straw among the varieties. Creole gave the highest yield of seed, followed by Palmetto. Monetta ranked third; it gave a higher yield of seed than the rest of the varieties, except Nanking. The differences in yield of seed of the other varieties were statistically insignificant.

Palmetto and Creole gave the highest yield of straw in the wet-season culture; these two varieties, however, did not differ statistically. Seminole, which ranked next, gave a higher yield than any of the rest of the varieties. The differences in yield of straw of the rest of the varieties were insignificant.

The results show that Creole, Palmetto, and Monetta yielded the most seed and straw, probably because they were very much taller than the other varieties. The yield of seed ranged from 8.10 to 15.74 cavans a hectare; the yield of straw, from 645.83 to 1,739.58 kilograms a hectare. Based on the biggest yield and the largest size of seed in the dry- and wet-season cultures, Creole, Palmetto, and Monetta were the three best varieties. Seminole may also be selected because it gave the highest yield of seed in the dry-season culture and had the biggest seeds.

SUMMARY

1. All of the eleven varieties of soybean tested were dwarfed and upright in habit of growth in the dry season. The seven selected varieties, when planted in the wet season, grew from medium tall to tall. All of them became branchy except Nanking. Some varieties were defoliated; in the others the leaves persisted till maturity.

2. Seminole had the largest seeds and Palmetto, the smallest.

3. The eleven varieties flowered and matured at practically the same time, except Seminole, which was the latest.

4. All the varieties tested were practically free from pests and diseases.

5. The yield of seed in the wet-season culture varied from 645.83 to 1,739.58 kilograms to the hectare.

6. On the basis of yield and size of seed in the dry-season and in the wet-season culture, Creole, Palmetto, and Monetta were considered the best. Seminole may be added because it outyielded all the other varieties in the dry season and had the largest seeds.

RECOMMENDATION

From the results of the test, the writers recommend that Creole, Palmetto, Monetta, and Seminole be tested, in comparison with Head-green and Ami, to determine their commercial merits in dry- and wet-season cultures.

THE GROWTH BEHAVIOR OF MANGOSTEEN AND ITS GRAFT-AFFINITY WITH SOME RELATIVES¹

LEON G. GONZALEZ AND QUIRINO A. ANOOS

Although the mangosteen is a popular fruit, very little is known of its culture, especially in the Philippines where the idea seems to prevail that it will not fruit outside of Sulu and Mindanao. Hence, a study was conducted from November, 1949, to March, 1951, to determine the behavior of eleven-year-old mangosteen plants after balling in the nursery rows and transplanting in the open and to test the graft-affinity of the mangosteen with some of its close relatives. As the work progressed, observations were also made on the flowering and fruiting behavior of three bearing trees in the College vicinity and the germination of the seeds obtained from these trees. Most of the work was done in the College of Agriculture at Los Baños. In addition, two trees in the College of Forestry and two others in Santa Mesa, Manila, were observed.

MATERIALS AND METHODS

Plants used. Three full-grown trees of bearing age, 51 eleven-year-old plants, 11 eight-month-old seedlings, 8 seven-month-old seedlings, and 23 five-month-old seedlings of mangosteen were utilized.

Seeds, seedlings of various sizes, and established trees of the following 13 species of *Garcinia* and near-relatives were used as stocks for mangosteen scions: *Garcinia kydia* Roxb.; *G. binucao* (Blco.) Chys.; *G. morella* Dest.; *G. venulosa* (Blanco) Choisy; *G. divis* Pier; *G. dulcis* (Roxb.) Kurz; *Garcinia* sp.; *Callophyllum inophyllum* Linn.; *C. blancoi* Pl. and Tr.; *Rheedea edulis* Pl. and Tr.; *Cratoxylon cochinchinense* (Lour.) Blume; *C. blancoi* Pl. and Tr.; and *C. celebicum* Blume.

Balling. The seeds obtained from Bali, Indonesia, were sown in July, 1939; the seedlings were transferred to pots of increasing sizes and finally placed in kerosene cans in 1941. The 2½-year-old mangosteen seedlings were arranged in rows of three in plots four meters long and one meter wide. The plots, made of small stones held together by garden soil and cemented around the border, were raised five centimeters from the ground. The plants remained in kerosene cans; consequently, many roots went through the containers, some deep into the soil between the stones. The plants were

¹ Central Experiment Station Contribution No. 1637. From the thesis presented by the junior author for graduation, 1951, with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of the senior author.

balled into balls 35 centimeters in diameter and 45 centimeters deep and planted not deeper than 10 centimeters in the drums, which were filled with surface soil heavier in texture than ordinary soil. The soil was pressed compactly around the roots of the plants.

The effect of digging on the balled plants were observed according to the following criteria for injury: (1) wilting of leaves, (2) color changes in the leaves, (3) shedding of leaves, and (4) dehydration of stems and branches. Daily observations were made until the plants had either recovered or completely died. The plants were considered to have recovered when their leaves had regained their color, gloss, and turgor and when the wrinkled, dried, fibrous, and dull-colored branches had become roundish, fleshy, slightly translucent, and brightly colored. The appearance of new leaves was also noted.

Flowering and bearing characteristics. The flowering and fruiting characteristics of the three mangosteen trees of bearing age were observed. Two of the trees are in the yard of Professor I. Elayda, near the entrance to the College of Agriculture campus, and the third is in the College of Forestry campus in the lot formerly occupied by the late Professor A. de Mesa.

Performance of mangosteen transplanted in different locations. Because of the limited number of plants on hand, only a few trees could be observed. Four plants are along the Molawin Creek, two are in the nursery, two near the Administration Building, two in the College of Forestry campus, twenty-eight in front of the Catholic Church, and two in Santa Mesa Heights, Manila. Monthly measurements of the height and girth of the main stems, the number of leaves formed, and the length and width of the foliage are presented in table 1.

Diseases and pests. One of the trees near the Administration Building was infested by caterpillars which Dr. Cendaña of the Department of Entomology identified as *Orgyia* sp., of the family Lymantridae, (Liparidae). The larvae, which fed on the tender, newly-formed leaves, were hand-picked until they were properly controlled.

Germination tests. The seeds obtained locally and those received from Manila and Zamboanga in September and October, 1950, were sown separately.

Graft-affinity of the mangosteen with its near-relatives. In the graft-affinity tests by inarching, both the scions and the stocks were supported by their own root systems. After the inarches were severed, they were placed in growing chambers constructed of adobe stone and glass where air humidity was kept at a high level. In one experiment were used stocks two to three years old, and in the other, seedlings six to eight months old.

RESULTS AND DISCUSSION

Size of ball and extent of root injury. The cans containing the twelve-year-old plants had been placed close to one another; hence, it

was not possible to dig large holes to minimize root injury. Eight of the plants could be lifted easily without balling because their roots had not yet passed through the bottom and sides of their cans. Eight plants were balled approximately 40 centimeters deep and 30 centimeters in diameter. Three to five roots were cut from each plant. Twelve plants were balled 45 centimeters deep and 30 centimeters in diameter. A similar number of roots were injured. Eighteen plants had rectangular balls $35 \times 35 \times 40$ centimeters. The number of injured roots ranged from two to ten. Four plants were balled 50 centimeters in diameter and 40 centimeters in depth. All the roots were apparently included in the balls. Two plants were kept in the nursery rows as control.

Root system of the mangosteen. On the average, each plant more than a meter tall had five to six straight and elongated primary roots which looked like tap roots. Only one or two of these roots developed very fine, short, secondary roots at what appeared to be nodal regions. Compared with other fruit plants, the mangosteen has a less developed root system. Similar observations were reported by MacMillan (1946), Fairchild (1947a and b), and Hume (1947). One may well wonder how so sparse a supply of roots can maintain the balance of a much larger top.

Injury from balling. Perhaps because of the thickened, fibrous nature of the leaves, wilting could not be detected easily. It took two to five days, sometimes longer, for the injury to manifest itself. In the mildly injured plants, the younger leaves tended to curl inward or bend slightly. In about ten days, the tip of the stem or branches bent markedly. The more severely injured plants showed wrinkling and drying of the stem, usually starting at the tip and sometimes extending downward to the main trunk. The leaves and stems turned dull-colored and grayish and later became yellowish and slightly brown. The leaves either dropped off or remained on the plant until they were removed.

Recovery of balled plants. Two of the trees set out in October, 1950, had not fully recovered at the end of the observation period. On the average, the leaves began to regain their turgidity, color, and previous appearance about three months after balling.

The formation of new leaves is not necessarily an indication of recovery because some of the branches which formed new leaves soon appeared to die. Much later, however, the plants revived. The full recovery of the stem from dehydration is the most dependable sign of recovery.

Leaf-pruning and shading. To determine the extent of leaf-pruning and the degree and duration of shading needed by balled mangosteen plants, eight uniform plants were picked out and balled carefully, the balls measuring $30 \times 30 \times 40$ centimeters each. Three degrees of pruning were made on six of the plants, leaving two plants unpruned for control. In the first set of two plants all the leaves

were pruned to one-half; in the second, one-half of all the leaves were cut off in the middle; in the third, one-third of all the leaves were pruned; and in the fourth, all the leaves were left unpruned. The eight plants representing the three degrees of pruning and the control were then divided into two lots and placed in the shade. The shade of one lot was a trellis with bamboo slats four centimeters wide and two to three centimeters apart to provide diffused light. The other lot was placed under a similar shade of bamboo slats on which coconut fronds were added so as to give much denser shade. Both lots were given the same care.

Three days after balling, the plants with unpruned leaves showed considerable wilting. The extent of the wilting was inversely proportional to the degree of leaf-pruning of the plants. The leaves near the tips of the stems and branches were the first to fold or curve in. After six or seven days, the branches of the unpruned plants began to bend and the leaves to fold in. Because the branches shriveled, the leaves were pruned to one-half on the twentieth day.

In this experiment, it was noted that the plants under the denser shade suffered much less than those under the less dense shade. Their condition, however, required that in addition to shading, artificial mist from a rubber hose be applied to increase the atmospheric humidity. The writers noted that pruning the leaves of balled mangosteen, placing the plants in dense shade, supplying them with plenty of water, and increasing the atmospheric humidity around them minimized the injury and hastened recovery. Of the 52 balled plants, only one shriveled down to 10 centimeters above the ground, but its stump produced a new shoot.

Leaf production of twelve-year-old mangosteen plants. The computed proximate total area of leaves formed after transplanting were as follows: on the Forestry campus, 20,942.60 square centimeters; near the Molawin Creek, 19,927.08 square centimeters; in Santa Mesa Heights, Manila, 19,047.25 square centimeters; in front of the Catholic Church, 16,961.73 square centimeters; near the Administration Building, 9,009.24 square centimeters; and in the Nursery, 7,471.52 square centimeters. Although the untouched trees in the Nursery produced the least number of leaves, they appeared most healthy. The influence of transplanting on the formation of new leaves and on the vigor of the trees were not determined in this work.

Flowering and fruiting habits of full-grown trees. The presence of two bearing trees in the College of Agriculture and one in the College of Forestry indicates the adaptability of mangosteen to local conditions.

The two bearing trees in the yard of Professor I. Elayda fruited for the first time in 1948, 28 years after planting from seeds secured from Jolo. The tree in the College of Forestry planted by Professor H. M. Curran in 1920 fruited for the first time in 1934 and every year thereafter, except in 1950 when most of the fruits dropped,

perhaps because of the large number of branches that had been marcotted.

The trees varied in height from 560.0 to 669.5 centimeters; in girth of trunk, from 52.0 to 54.0 centimeters; in spread of crown, from 530.0 to 646.0 centimeters; in length of leaves, from 20.98 to 23.35 centimeters; and in width of leaves, from 10.71 to 11.6 centimeters. The tree in the Forestry campus is partly shaded by tall forest trees, whereas those in the College of Agriculture campus are densely planted with other trees.

Flowering and fruiting characteristics of the mangosteen. According to Popenoe (1920), mangosteen trees bloom twice a year in Ceylon, once in August and again in January. The first crop ripens in January and the second, in July and August. In Trinidad, the fruiting seasons are said to be July and October. Popenoe estimated light crop at 100 fruits and heavy crop at 500 to 600 to a tree of full bearing age.

The two trees in the College of Agriculture campus flowered for six days beginning April 20, 1950. Tree No. 1 produced 86 flowers, 79 of which set fruit; 75 fruits were finally harvested. Tree No. 2 produced 42 flowers, set 38, and matured 35 fruits. The trees have been bearing for three years.

The quality of the fruit produced in Los Baños compares favorably with the best obtained from Zamboanga and from fruit markets in Manila.

Physical analysis of the fruits. Fruits from the two trees growing in the College of Agriculture and fruits from Manila did not show marked or consistent differences in physical characters. The weight of the whole fruit varied from an average of 54.5 to 74.9 grams, and the percentage of pulp ranged from 29.34 to 25.00. Similarly, the differences in thickness of rind, number and weight of seeds to a fruit, and texture and taste of the pulp were not marked enough to justify varietal or even form designation. All the fruits examined possessed the characteristic delicious taste and melting quality which make the mangosteen superior to other fruits.

Germination. The results of germination tests showed that seeds from fresh fruits gave 83.33 to 85.71 per cent germination, or an average of 84.91 per cent for the three lots. Seeds from fruits which had begun to decay in transit gave only 71.43 per cent germination.

A delay in planting adversely affected the viability of the seeds. Seeds sown immediately after they had been collected gave 85.71 per cent germination; those planted three to five days later, although previously kept in an earthen pot inside the laboratory, gave only 71.43 per cent. Neither did the addition of ground charcoal to freshly gathered seeds stored in a wooden box prolong viability. Thus, a delay of about 15 days reduced the percentage of germination to 21.43. Dr. and Mrs. L. G. Gonzalez, however, packed seeds they

had collected in Bali in moist sphagnum moss in tightly covered cigarette cans for three months and obtained over 50 per cent germination.

Rate of growth of the seedlings. The mangosteen developed slowly. Four months after germination, the seedlings had an average height of 7.08 centimeters and an average of 2.25 leaves. Thereafter, they grew about 1.5 centimeters high and produced a pair of leaves every two months. In ten months, the seedlings of *Garcinia kydia* attained an average height of 20.8 centimeters and produced 12.5 leaves; those of *G. morella* had 20.7 leaves and an average height of 19.0 centimeters. But *G. mangostana* produced only 3.5 leaves and grew a total height of 8.1 centimeters. The average monthly increase in height of the different kinds of seedlings was 0.8 centimeters for mangosteen, 2.1 centimeters for *G. kydia*, and 2.0 centimeters for *G. morella*.

Propagation by marcottage. In the 46 marcots of lateral branches of varying sizes on bearing trees in the College of Forestry, the ordinary ringing method was used. Coconut husks were used for wrapping. In a similar marcotting of the two bearing trees in the College of Agriculture, gallon cans were used as wrapping for the lateral branches and kerosene cans for the main stems.

Not one of the 55 marcots rooted. After three to four months, 27.27 per cent of the marcots died, probably due to damage of the xylem vessels by the ringing. The healing of 21.81 per cent of the ringed stems suggests incomplete removal of the bark. In 45.45 per cent, the branches, though callused, did not produce roots.

Inter- and intra-generic graft-affinity of the mangosteen. Of the different near-relatives of mangosteen tested for stocks, two- to three-year old seedlings of *G. kydia* and *G. venulosa* showed compatibility, though the percentages of union were 10 for *G. kydia* and 12 for *G. venulosa*. Three- to four-month-old *G. morella* seedlings also proved graft-compatible with mangosteen.

Mangosteen did not unite with the other stocks used (*Callophyllum inophyllum*, *C. blancoi*, *Cratoxylon cochinchinense*, *C. celebicum*, *Rheedea edulis*, *Garcinia binucao*, *G. divis*, *G. dulcis*, and an unidentified species of *Garcinia*), although most of the inarches remained green and fresh for several weeks after they had been severed.

SUMMARY

1. Two or three good seeds may be obtained from a normal-sized mangosteen fruit. Because of their highly perishable nature, the seeds should be planted with the least delay. Only 50 per cent of freshly gathered seeds packed in moist sphagnum moss in tightly closed containers were viable in two months. Of unpacked seeds or seeds packed in ground charcoal, only 21.62 per cent were viable in 15 days.

2. The seeds germinated in 19.5 days. They increased in height at the rate of 0.26 centimeters a month and produced a pair of leaves every two months. The two-year-old seedlings were 24 centimeters high.

3. Twelve-year-old plants were, on the average, 248.7 centimeters in height, 10 centimeters in girth, and 160.8 centimeters in expanse; they had 144.7 leaves with an approximate area of 104.2 square centimeters. In balling, it was not difficult to dig up the plants and wrap the soil because of the sparsity of the root systems. Pruning the leaves, providing the plants with dense shade, watering them liberally, and maintaining a high atmospheric humidity by nozzle-produced mists exerted a marked influence on the rate of recovery of the balled plants. Balled plants were ready to set out in one to three months.

4. Young and old seedlings of two genera of the family *Guttiferae* were not graft-compatible with the mangosteen. Of the thirteen species of *Garcinia*, three, *G. kydia*, *G. venulosa*, and *G. morella*, united with mangosteen. Union was more rapid in 1½- to 2-month-old seedlings than in the older stocks.

5. The trees grown in Los Baños produced fruits with an eating quality equal or superior to that of fruits bought from the markets in Manila and Zamboanga. As the trees are still growing, increase in yields may be expected. The fruits from trees in Los Baños had an average weight of 74.4 grams. The rind weighed an average of 50.50 grams. The number of seeds was 1.6; the weight was 2.4 grams. The pulp weighed 26.05 grams. The values of the parts in percentage were as follows: rind, 67.92; seed, 3.15; and pulp, 28.74.

6. All the 55 marcotted branches from different parts of the plant did not root.

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TABLE 1
The 12-year-old mangosteen trees planted under different conditions

PLANT NO.	DATE TRANS-PLANTED	LOCATION	ELEVATION	KIND OF SOIL	SUN-LIGHT EXPOSURE	ATMOSPHERIC HUMIDITY	DATE OBSERVED	SIZE OF PLANTS			NO. OF LEAVES AT PLANTING	AVERAGE SIZE OF 10 LEAVES		
								Height	Girth	Spread		Length	Width	Area
			meters					cm.	cm. ^a	cm.		cm.	cm.	sq. cm.
1	Not moved	Nursery	23	Lipa clay loam	Partially shaded	Semi-humid	Feb. 24, 1951	260	8.6	175	156	12.4	6.0	74.4
2	"	"		"	"	"	"	230	11.5	125	41	12.8	6.1	78.08
3	August 31, 1950	In front of Catholic Chapel	25	"	"	Dry	"	259	10.5	180	400	14.84	5.82	86.08
4	"	"		"			"	282	9.8	185	205	15.15	6.71	101.65
5	May 14, 1950	Along Mola-win Creek	14	Alluvial (sandy)	Partially shaded	Humid	"	174	9.8	155	168	20.08	8.01	160.84
6	"	"			Not shaded		"	226.5	8.4	160	193	23.34	8.92	208.19
7	May 21, 1950	Near Adm. Bldg.	40	Lipa clay loam	Partially shaded	Semi-humid	"	194	8.0	168	51	12.11	5.25	63.57
8	"	"					"	255	12.0	155	68	7.27	4.10	29.80
9	August 14, 1950	College of Forestry Compound	105		Partially shaded	Humid	"	259	9.6	150	118	21.28	7.03	149.59
10	"	"			Not shaded		"	314	9.6	155 ^b				
11	August 12, 1950	Sta. Mesa Heights		Clay loam		Very dry	"	273	11.8		55	16.50	7.77	128.20
12	"	"					"	258	10.8		106	10.99	6.0	65.94

^a Taken 10 centimeters from the ground.

^b Found to be *Garcinia kydia* and not *mangostenia*.

COLLEGE AND ALUMNI NOTES

A group of ECA officials visited the College on November 16, 1951, and observed the work of various departments. Among the visitors were Mr. E. J. Bell and Mr. Mark Williamson, director and assistant director, respectively, of the agricultural division, U.S. special technical and economic mission to the Philippines.

Several instructors were added to the faculty of the College. Their salaries come from funds made available by the ECA and PHILCUSA. Mr. Rodolfo R. Mondoñedo, a 1951 B.S.C.A. graduate of the U.P. College of Engineering, has been appointed instructor in the Department of Agricultural Engineering. Another new instructor in this department is Mr. Alberto L. Yap, a 1949 B.S.M.E. graduate of the University.

Mr. Antonio D. Bustrillos, '48, was appointed instructor in agricultural chemistry; Mr. Eugenio V. Mendoza, '48, instructor in agricultural botany; and Mr. Mario O. San Juan, '50, instructor in animal husbandry.

Mr. Luciano S. B. Fernandez, a 1931 B.S.B.A. graduate of the U.P., was appointed ECA accountant.

The institution of two new courses was approved at the meeting of the faculty on November 3, 1951. These courses are Agricultural Economics 21, Elementary Economic Statistics; and Agricultural Education 35, Organization and Administration of Agricultural Extension Work.

A scientific meeting of the Los Baños Biological Club was held on October 26, 1951, at the Agricultural Chemistry Lecture Hall. The following paper was read and discussed: "Studies on foliar diagnosis: I. Nitrogen relations," by J. R. Velasco and R. P. Novero.

Mr. Bernardino Q. Ballesteros, instructor in agricultural botany, read at the Los Baños Biological Club meeting, held on November 23, 1951, a paper on the effects upon the growth and yield of upland rice plants of adding animal manure to fertilized and nonfertilized soils.

The following were recently elected officers of the College Student Body Organization for the second semester of the academic year 1951-52 and the first semester of the academic year 1952-53: Rodolfo Ylarde, president; Romualdo Eusebio, vice-president; Justina Mabesa, secretary; Concepcion Valera, treasurer; Orlando Sacay and Ibarra Santos, U.P. Student Council representatives; and Onofre Griño, Collegian representative. Dr. V. C. Calma was unanimously re-elected adviser of the organization.

The enrollment for the second semester, 1951-1952, is 644, or 154 less than that of the first semester. The students are classified as follows: freshmen—306, sophomores—173, juniors—90, seniors—

64, postgraduates—8, and special students—3. These figures do not include 61 cross-registrants from the College of Forestry.

Sixteen girls are now enrolled in the Home Technology curriculum.

The enrollment in the Rural High School is 198, or 13 less than that of the first semester.

The following students were awarded University scholarships this semester: Orlando J. Sacay, Ibarra S. Santos, and Concepcion L. Valera. College scholarships were awarded to the following: Fernando A. Bernardo, Rodolfo M. Ela, and Severino R. Santos, Jr.

The P.M.T. boys and the Boy Scouts of the U.P. Rural High School visited the historical home of General Emilio Aguinaldo in Kawit and the U.S. Naval Base at Sangley Point on November 24, 1951. On the way home, the party stopped at Sunset Beach to swim. Scoutmasters M. V. Jarmin and P. S. Fajardo and P.M.T. instructors F. T. Ramos and C. R. Las Marias accompanied the boys.

Mr. Leopoldo S. Castillo, '48, has joined the staff of the Department of Animal Husbandry as instructor. He was formerly with the faculty of the St. Paul's Academy in Inabanga, Bohol.

STATION

LIST OF AVAILABLE PUBLICATIONS

- No. 2.—Bud Rot of Coconut *By G. O. Ocfemia*
 No. 8.—Horse Breeding in the Philippines *By V. Villegas*
 No. 11.—The New College Copra Drier *By Moises M. Kalaw*
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